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(54) **TELEPHONE SWITCHBOARD AND ELECTRONIC DEVICE FOR PROVIDING POWER TO LOAD HAVING DIFFERENT RESISTANCE VALUES AT DIFFERENT OPERATION MODES**

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(51) **Int. Cl.**

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H04M 3/08	(2006.01)
H04M 1/24	(2006.01)
H04M 9/00	(2006.01)
H04M 1/00	(2006.01)

(52) **U.S. Cl.**
USPC ... **379/20**; 379/29.03; 379/29.04; 379/395.01

(58) **Field of Classification Search** 379/1.01, 379/9.06, 20, 29.03, 29.04, 29.07, 30, 31, 379/32.01, 32.04, 387.01, 395.01, 399.01, 379/413, 413.01
See application file for complete search history.

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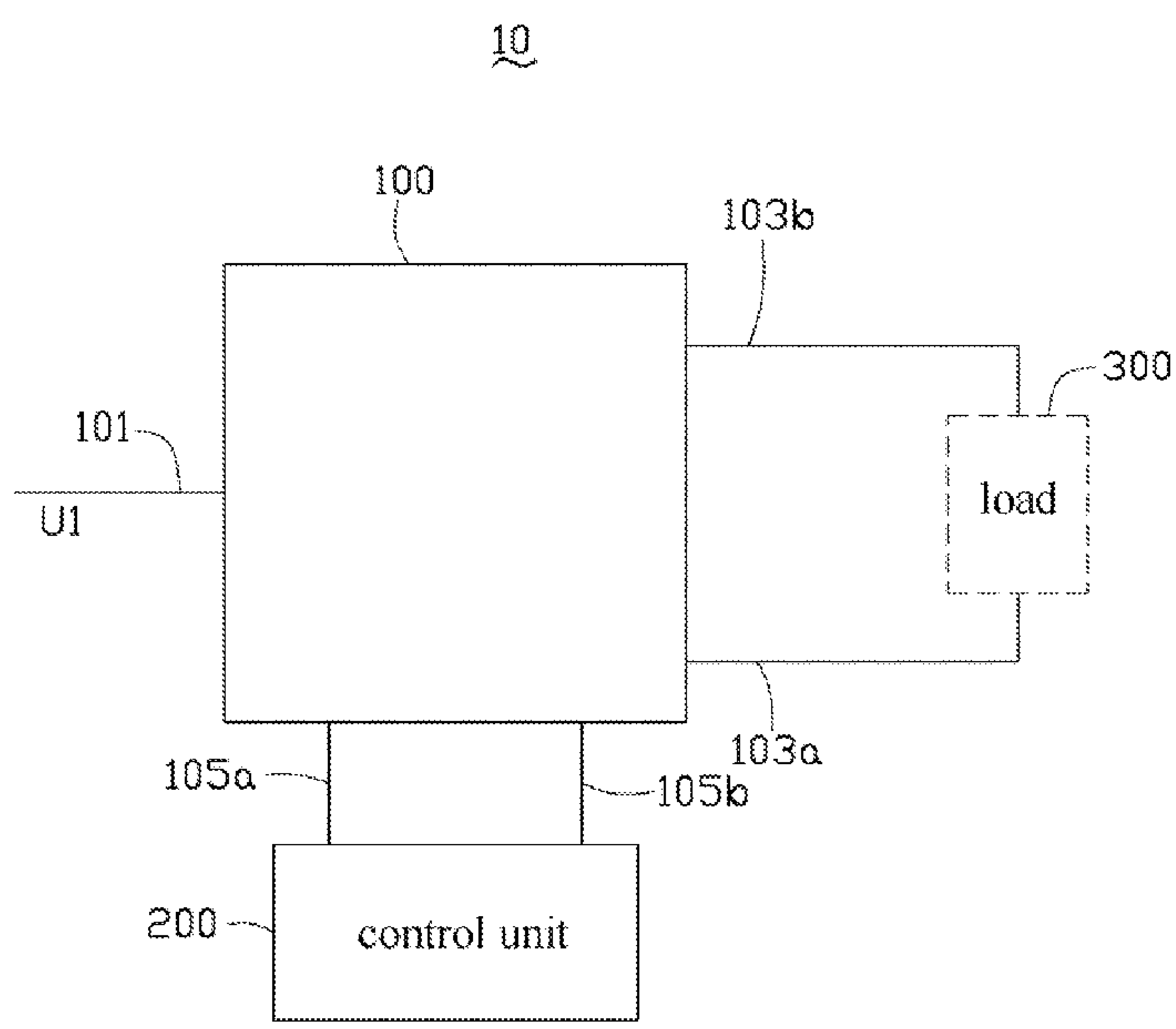
(57) **ABSTRACT**

A telephone switchboard provides various operating voltages to a telephone in different operation modes. The telephone switchboard includes a control unit, an output control circuit and a voltage converter. The control unit detects the operation mode of a telephone and generates control signals to the output control unit. The output control unit controls direction of current flowing through the telephone according to the control signal, and generates a feedback signal according to any change in the operation mode of the telephone. The voltage converter receives the feedback signal and converts the received power to a suitable output operation voltage according to the feedback signal. The telephone switchboard is capable of providing various operation voltages to the telephone in the different operation modes.

20 Claims, 4 Drawing Sheets



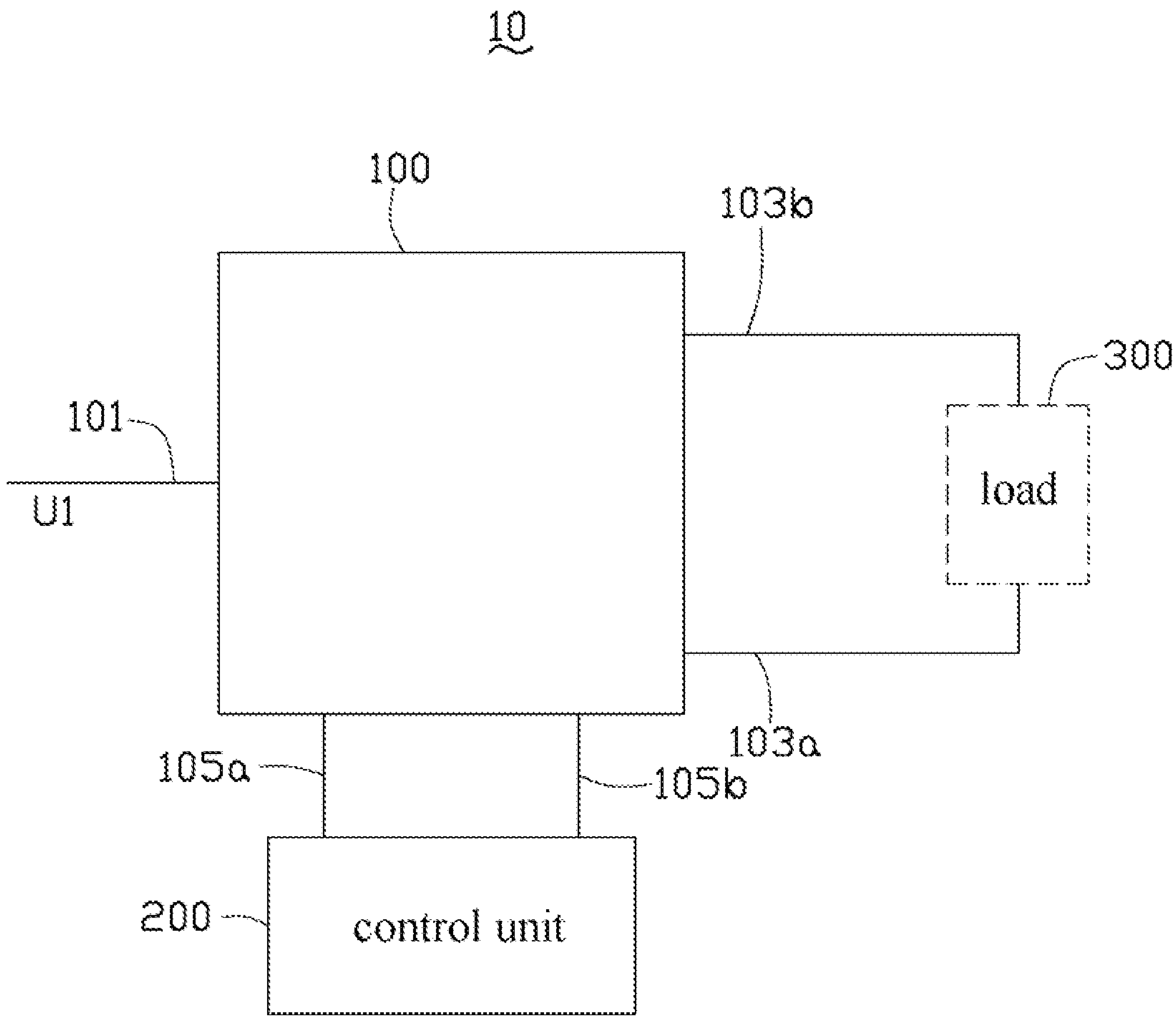


FIG. 1

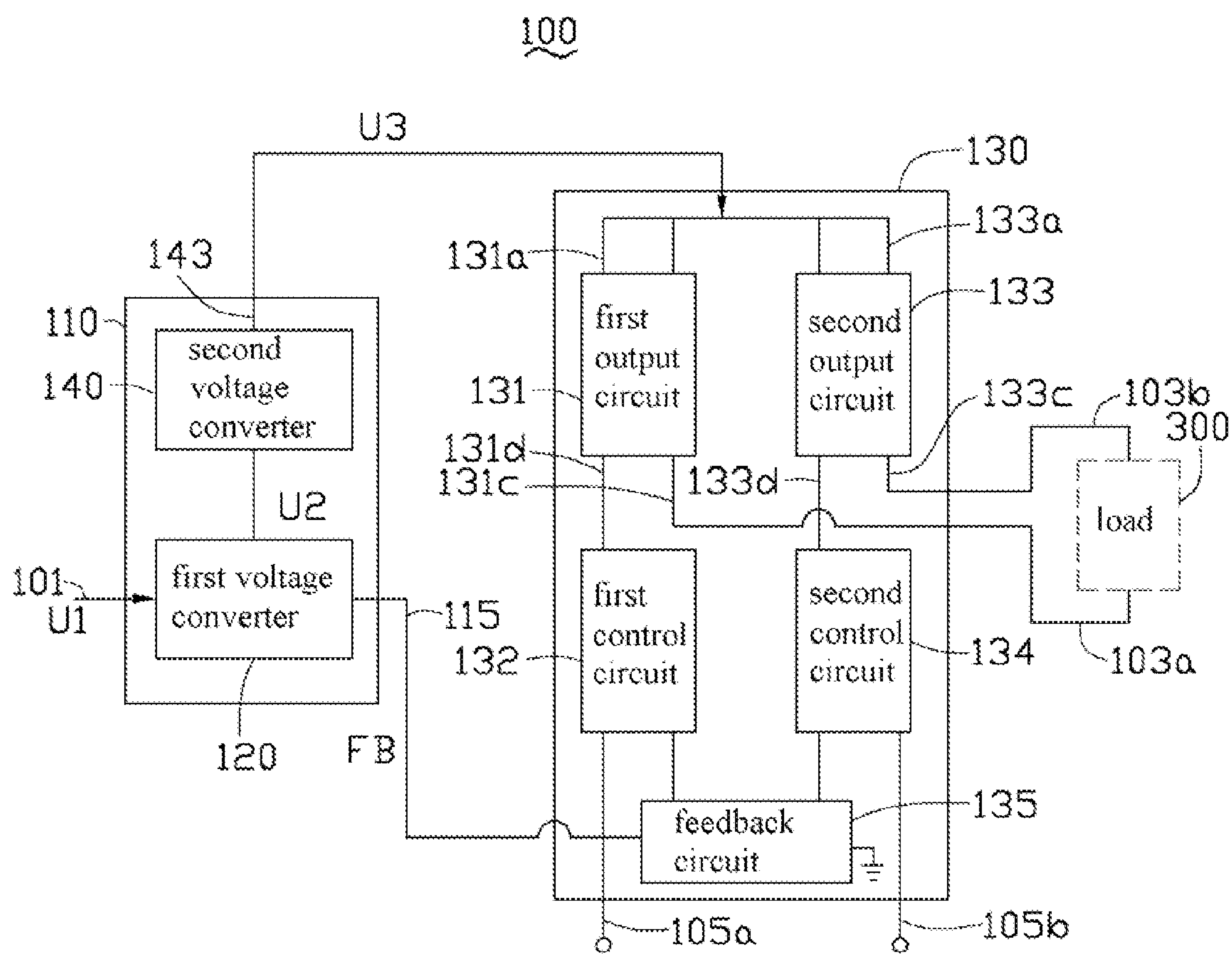

100
U3
130
133a
131a
143
133
110
140
second voltage converter
first output circuit
second output circuit
131
133c
103b
300
131d
131c
133d
U2
load
101
U1
first voltage converter
115
first control circuit
second control circuit
132
134
103a
120
FB
feedback circuit
135
105a
105b

FIG. 2

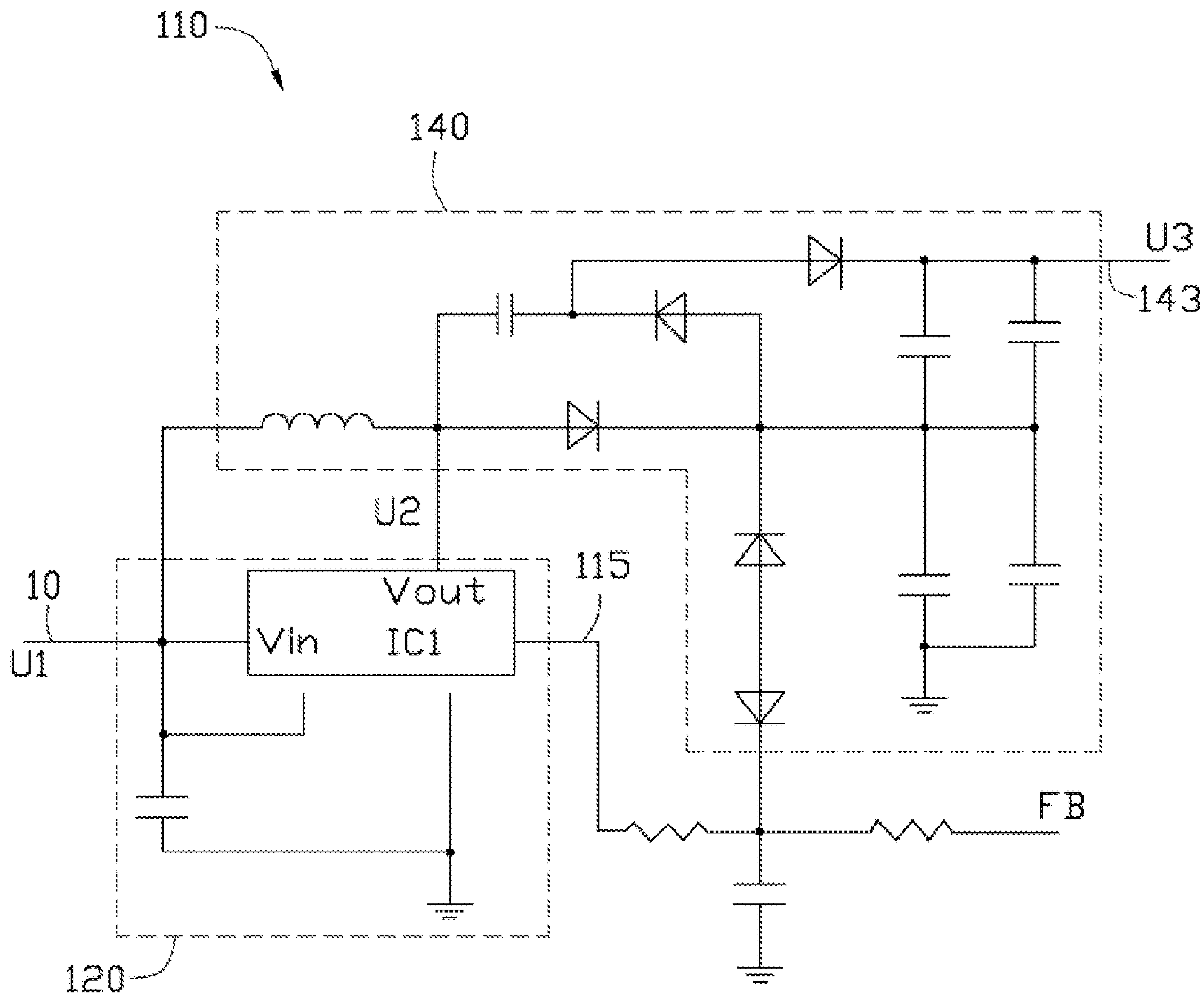


FIG. 3

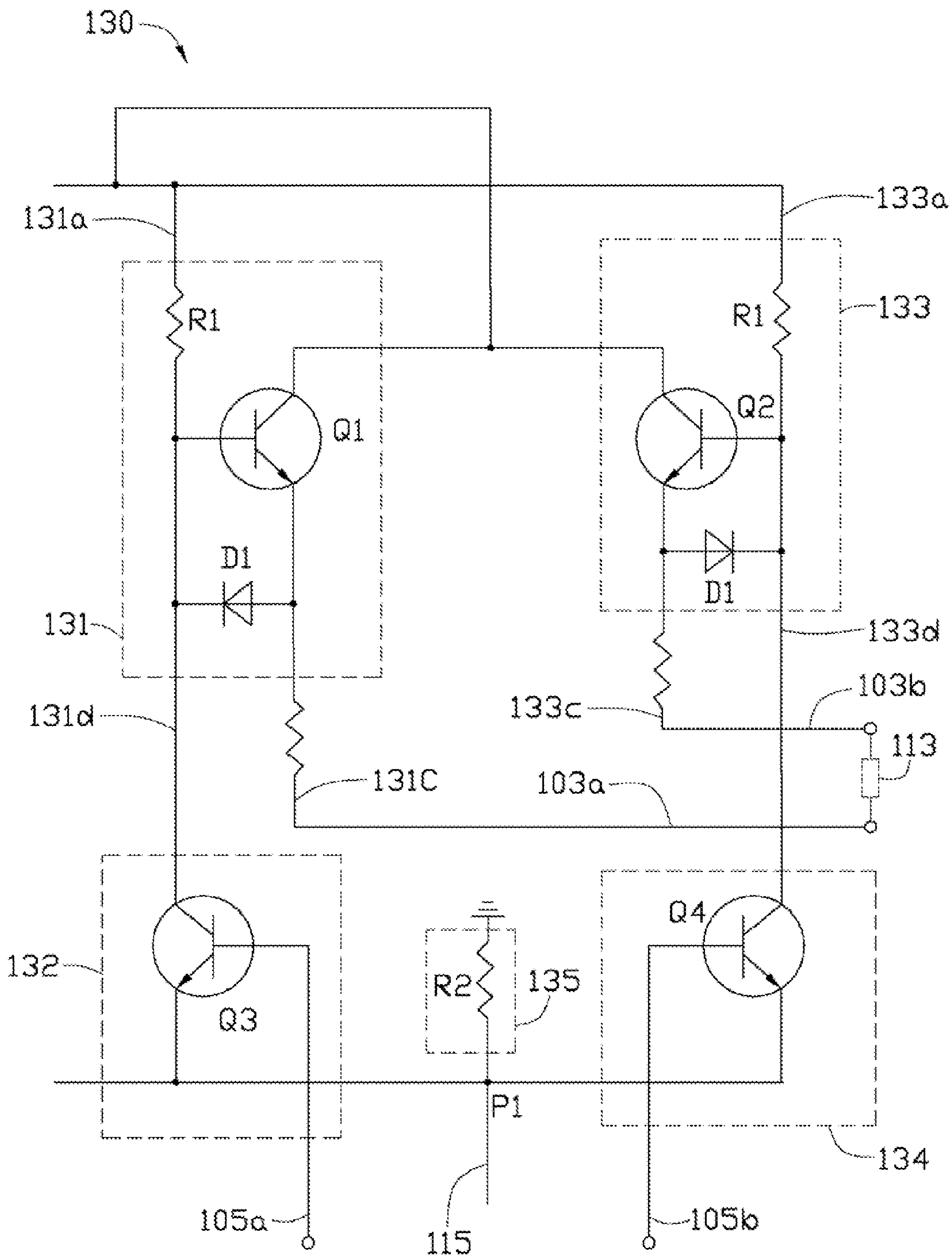

130
131a
133a
R1
R1
133
Q1
Q2
D1
D1
131
133d
103b
133c
131d
113
131C
103a
Q4
132
R2
135
Q3
P1
134
105a
115
105b

FIG. 4

TELEPHONE SWITCHBOARD AND ELECTRONIC DEVICE FOR PROVIDING POWER TO LOAD HAVING DIFFERENT RESISTANCE VALUES AT DIFFERENT OPERATION MODES

BACKGROUND

1. Technical Field

The disclosure generally relates to an electronic device for providing power to a load that has different resistance values in different operation modes, and more particularly, to a telephone switchboard coupled between a network and a telephone.

2. Description of Related Art

Generally, a telephone has three operation modes including an on-hook state, a dialing state and a dialog state. In the on-hook state, the telephone is on standby and no calling signals are input to the telephone. In the dialing state, a calling signal is input to the telephone and the telephone is ringing. In the dialog state, users are able to transmit voice information to each other via the telephone. However, in these operation modes, the telephone has different operation resistance values. For example, when the telephone is in the on-hook state or in the dialing state, the telephone has an operation resistance value far greater than the resistance value when the telephone is in the dialog state. Therefore, a telephone switchboard is required to have an ability to generate different operation voltages relative to different modes of the telephone.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings are included to provide a further understanding of the disclosure. The drawings illustrate embodiments of the disclosure and, together with the description, serve to explain the principles of the disclosure.

FIG. **1** is a block diagram of a telephone switchboard according to an exemplary embodiment of the present disclosure, the telephone switchboard including a power supply circuit.

FIG. **2** is a block diagram of the power supply circuit of FIG. **1**, the power supply circuit including a voltage converter and an output control circuit.

FIG. **3** is a circuit diagram illustrating an exemplary embodiment of the voltage converter of FIG. **2**.

FIG. **4** is a circuit diagram illustrating an exemplary embodiment of the output control circuit of FIG. **2**.

DETAILED DESCRIPTION

Reference will be made to the drawings to describe certain exemplary embodiments of the present disclosure in detail.

In the present disclosure, the electronic device is capable of providing power voltages to at least one load. The at least one load has different resistance values at different operation modes. Accordingly, the electronic device is required to provide different voltages, i.e. different voltage values, to the load according to the current operation mode. In the following description, the telephone switchboard is configured to control dialog channels between a call-in telephone and a call-out telephone, and simultaneously, is configured to provide voltages to the call-in telephone. The call-in telephone includes an electronic connector for receiving the voltages. The electronic connector includes at least two voltage input terminals respectively as positive and negative phase voltage input terminals of the telephone for receiving the voltages.

In the embodiment, the telephone has three operation modes including an on-hook state, a dialing state and a dialog state. The resistance value of the telephone in an on-hook state or in a dialing state is greater than the resistance value of the telephone in a dialog state, therefore an operation voltage provided to the telephone in the on-hook or the dialing state is greater than the operation voltage supplied to the telephone when the telephone is in the dialog state. In the dialing state, although the operation voltage has a similar voltage value to that provided to the telephone when the telephone is in the on-hook state, the direction of current flowing through the telephone is periodically and alternately inverted. That is, the operation voltage has a square-wave signal waveform that continuously and periodically inverts between a positive level and a negative level.

Referring to FIG. **1**, a block diagram of a telephone switchboard **10** according to an exemplary embodiment of the present disclosure is shown. The telephone switchboard **10** includes a power supply circuit **100** and at least one control unit **200**. The telephone switchboard **10** is connected to at least one load **300** (i.e. the telephone). The control unit **200** is configured to detect the operation mode in which the load **300** is working and generate control signals accordingly to the power supply circuit **100**. The power supply circuit **100** provides different operation voltages to the load **300** according to the received control signals.

The power supply circuit **100** includes a voltage input terminal **101**, a first control terminal **105***a*, a second control terminal **105***b*, a first output terminal **103***a* and a second output terminal **103***b*. The voltage input terminal **101** receives an original voltage U1 (i.e. a low direct current voltage) generated from an external circuit (not shown). The first and second control terminals **105***a*, **105***b* are connected to the control unit **200** for receiving the control signals that indicate the operation mode of the load **300**. In the embodiment, when the control unit **200** detects that the load **300** is in the on-hook state, the control unit **200** generates a high level signal (i.e. a logical 1 or a positive DC voltage) to the first control terminal **105***a*, and a low level signal (i.e. a logical 0 or a negative DC voltage) to the second control terminal **105***b*. Both of the high level signal and the low level signal serve as the control signals when the load **300** is working on the on-hook state. When the control unit **200** detects a change of state of the load **300** from the on-hook state to the dialing state, the control unit **200** generates a first driving signal and a second driving signal as the control signals to the first and second control terminals **105***a*, **105***b*, respectively. The first and second driving signals can be, for example, a binary digital signal or an alternating voltage signal. When the first and second driving signals are the binary digital signals, each bit in the first driving signal has a different value from a corresponding bit in the second driving signal. For example, when the first driving signal is 01010101, the second driving signal is 10101010. When the first and second driving signals are alternating voltage signals, the polarity of the first driving signal is inverted to that of the second driving signal. When the control unit **200** detects that the load **300** is in the dialog state, the control unit **200** outputs the low level signal and the high level signal as the control signals to the first controlling terminal **105***a* and the second controlling terminal **105***b*, respectively. The two output terminals **103***a*, **103***b* are connected to an interface circuit (not shown) of the load **300**, so that the power supply circuit **100** supplies the voltages to drive the load **300** via the interface circuit.

Referring to FIG. **2**, a block diagram of an exemplary embodiment of the power supply circuit **100** is shown. The power supply circuit **100** includes a voltage converter **110** and an output control unit **130**. The voltage converter **110** receives the original voltage U**1**, and includes a feedback terminal **115** for receiving a feedback signal FB that indicates a current value of the load **300**, so that the voltage converter **110** converts the original voltage U**1** to the correct voltage for the current mode of operation (output operation voltage U**3**). In the embodiment, the feedback signal FB can be, for example, a current feedback signal output from the output control unit **130**. More details are described as follows.

The voltage converter **110** can be, for example, a DC to DC voltage converter, and preferably a boosting circuit. In the embodiment, the voltage converter **110** may include a first voltage converter **120** and a second voltage converter **140**. The first voltage converter **120** is configured to boost the original operation voltage U**1**, thereby generating a primary operation voltage U**2**. The second voltage converter **140** receives the primary operation voltage U**2** and converts the voltage U**2** to the output operation voltage U**3**. Referring also to FIG. **3**, the first voltage converter **120** can preferably be for example a boosting integrated circuit IC**1**. The boosting integrated circuit IC**1** includes at least one of a current feedback pin, a voltage feedback pin as the feedback terminal **115** of the voltage converter **110**, an output terminal Vout for outputting the output operation voltage U**3**, and a voltage input terminal Vin connected to the voltage input terminal **101** for receiving the original voltage U**1**. The second voltage converter **140** can be for example a voltage doubling circuit or a voltage pump formed by a plurality of discrete components, such as inductors, diodes and capacitors. An output terminal **143** of the second voltage converter **140** is configured to output the output operation voltage U**3**.

The output control circuit **130** receives the output operation voltage U**3** and controls polarities of the output operation voltage U**3**, such as a positive operation voltage or a negative operation voltage, that is applied to the load **300**. That is, the output control circuit **130** controls the direction of current flowing through the load **300**. The output control circuit **130** includes a first output circuit **131**, a second output circuit **133**, a first control circuit **132**, and a second control circuit **134**. The first output circuit **131** includes a first input terminal **131***a* connected to the voltage converter **110** for receiving the output operation voltage U**3**, a first voltage output terminal **131***c* connected to the first output terminal **103***a*, and a driving terminal **131***d* connected to the first control circuit **132**. The first control circuit **132** is connected to the first control terminal **105***a* for receiving the control signals and determining whether the output operation voltage U**3** should be output to the load **300** via the first output circuit **131** according to the received control signals. The second output circuit **133** includes a second input terminal **133***a* connected to the voltage converter **110** for receiving the output operation voltage U**3**, a second voltage output terminal **133***c* connected to the second output terminal **103***b*, and a second driving terminal **133***d* connected to the second control circuit **134**. The second control circuit **134** is connected to the second control terminal **105***b* for receiving the control signals and determining whether the output operation voltage U**3** is being output to the load **300** via the second output circuit **133**, according to the received control signals. The first control circuit **132** and the second control circuit **134** are grounded via a feedback circuit **135**. The feedback circuit **135** feeds the current flowing through the load **300** as a current feedback signal to the feedback terminal **115** of the voltage converter **110**. The current feedback signal denotes the current flowing through the load **300**. The voltage converter **110** detects the current value of the current on the current feedback signal and regulates the voltage value of the output operation voltage U**3**.

When the load **300** is in the on-hook state, the first control circuit **132** receives the high level signal and the second control circuit **134** receives the low level signal, and they control the output operation voltage U**3** being output to the second output terminal **103***b* of the load **300** via the second output circuit **133**. The current flowing through the load **300** flows through the first output terminal **103***a*, the first control circuit **132** and the feedback circuit **135** to ground, in that order. Therefore, in the on-hook state, the second output terminal **103***b* is regarded as a positive phase input terminal of the operation voltage U**3**, and the first output terminal **103***a* is regarded as a negative phase input terminal of the operation voltage U**3**. Accordingly, the feedback circuit **135** feeds the current as the current feedback signal back to the feedback terminal **115**.

When the load **300** is in the dialing state, the first controlling terminal **105***a* and the second controlling terminal **105***b* receive the first driving signal and the second driving signal, respectively, so that the output operation voltage U**3** is alternately applied to the first output terminal **103***a* and the second output terminal **103***b*. The load **300** is provided with a voltage having a waveform like an alternating voltage. Since the load **300** has similar resistance values in the on-hook state and in the dialing state, the values of the feedback signals as to the amount of current, which are fed back to the feedback terminal **115**, are substantially similar, thereby the output operation voltage U**3** substantially maintains the first current value.

When the load **300** enters the dialog state, the first control circuit **132** and the second control circuit **134** receive the low level signal and the high level signal respectively, thereby controlling the output operation voltage U**3** which is output to the first output terminal **103***a* of the load **300** via the first output circuit **133**. The current flowing through the load **300** passes through (in this order) the second output terminal **103***b*, the second control circuit **134** and the feedback circuit **135** to ground. Therefore, in the dialog state, the first output terminal **103***a* is regarded as the positive phase input terminal of the operation voltage U**3**, and the second output terminal **103***b* is regarded as the negative phase input terminal of the operation voltage U**3**. Accordingly, the feedback circuit **135** feeds the current flowing through the load **300** as the current feedback signal back to the feedback terminal **115**. After entering the dialog stage, the resistance value of the load **300** decreases sharply, and the current flowing through the load **300** is larger than the current when the load **300** is both in the on-hook and dialing states. Therefore, the current with a larger value as the current feedback signal is fed back to the feedback terminal **115**. The voltage converter **110** detects the change of current and then regulates or decreases the first voltage value of the output operation voltage U**3** according to the current-level feedback signal.

Referring to FIG. **4**, a circuit diagram of the output control circuit **130** according to an exemplary embodiment of the present disclosure is shown. The first output circuit **131** includes a first switch element Q**1**, a diode D**1** and a resistor R**1**. Gate electrode, Source electrode and drain electrode of the first switch element Q**1** are connected to the first driving terminal **131***d*, the first input terminal **131***a*, and the first voltage output terminal **131***c*, respectively. Anode and cathode of the diode D**1** are connected to the drain electrode and the gate electrode of the first switch element Q**1**, respectively. The resistor R**1** is connected between the gate electrode and the source electrode of each element Q**1**. The second output circuit **133** has a circuit structure similar to the first output circuit **131**, and includes a second switch element Q**2** has a same transistor configuration as the first switch element Q**1**.

The first control circuit **132** has a circuit structure similar to the second control circuit **134**. The first and the second control circuits **132**, **134** include a third switch element Q**3** and a fourth switch element Q**4**. The gate electrodes of the third and fourth switch elements Q**2** serve as the first and second control terminals **105***a*, **105***b*. Source electrodes of the third and fourth switch elements are connected to the first and second driving terminals **131***d*, **133***d*, respectively, and drain electrodes are interconnected at a node P**1**. The feedback circuit **135** includes a sampling resistor R**2** connected between the node P**1** and ground. The node P**1** is connected to the feedback terminal **115** of the voltage converter **110**. The resistance value of the sampling resistor R**2** is far less than that of the resistor R**1**. For example. The ratio of the resistance values between the sampling resistor R**2** and the resistor R**1** ranges from 1:130 to 1:200. Preferably, when the resistance value of the resistor R**1** is 10 KΩ, the sampling resistor R**2** is 75Ω.

Referring through FIG. **1** to FIG. **4**, the detailed operation of the telephone switchboard **10** is described as follows:

In the beginning, the load **300** is in the on-hook state, the voltage converter **110** converts the original operation voltage U**1** and outputs the output operation voltage U**3** at a first voltage level. During the on-hook state, the control unit **200** generates the high level signal to the first control terminal **105***a* and the low level signal to the second control terminal **105***b*. The third switching element Q**3** is switched on. At this time, the first switching element Q**1** is switched off because the dividing voltage applied to the sampling resistor R**2** is too small to switch on the first switching element Q**1**. Simultaneously, the fourth switching element Q**4** is switched off, and accordingly the second switching element Q**2** is switched on. The output operation voltage U**3** is applied to the load **300** via the second output terminal **103***b* and the current flowing through the load **300** further flows through the first output terminal **103***a*, the diode D**1** of the first output circuit **131**, the third switching element Q**3**, the sampling resistor R**2** and the feedback circuit **135**. The current as the current feedback signal FB is fed back to the feedback terminal **115** of the voltage converter **110**. The voltage converter **110** detects the change of current value of the current feedback signal FB and maintains the output operation voltage U**3** at the first voltage value.

When the load **300** changes to the dialing state from the on-hook state, the control unit **200** generates the first driving signal and the second driving signal to the first control terminal **105***a* and the second control terminal **105***b*. The third and fourth switching elements Q**3**, Q**4** are alternately switched on at the same interval. Accordingly, the first and second switching elements Q**1**, Q**2** become switched-on in turn. Therefore, the first output terminal **103***a* and the second output terminal **103***b* alternate in serving as the positive input terminal for receiving the output operation voltage U**3**. During the dialing state, the level of the current flowing through the load **300** is maintained due to the resistance value of the load **300** being similar to that of the load **300** in the on-hook state. The current feedback signal FB experiences no change or changes only slightly, thereby controlling the voltage converter **110** to maintain the output operation voltage U**3** at the first voltage value during the dialing period.

When entering the dialog state, the control unit **200** generates the low level signal to the first control terminal **105***a* and the high level signal to the second control terminal **105***b*. The fourth switching element Q**4** is switched on and the third switching element Q**3** is switched off, so that the second switching element Q**2** is switched off and the first switching element Q**1** is switched on. The output operation voltage U**3** is applied to the load **300** via the first output terminal **103***a* and the current flowing through the load **300** further flows through the second output terminal **103***b*, the diode D**1** of the second output circuit **133**, the switched-on second switching element Q**2**, the sampling resistor R**2** and the feedback circuit **135**. Since the resistance value of the load **300** decreases sharply in the dialog state, the quantity of current indicated by the current feedback signal FB is larger than the feedback currents in the on-hook and the dialing states. The voltage converter **110** regulates the voltage value of the output operation voltage U**3**, thereby causing a proper second voltage value smaller than the first voltage value in the operation voltage U**3**.

In the telephone switchboard, the output control circuit **130** is capable of generating different control signals according to the operation modes of the load **300** to the voltage converter **110**, and the voltage converter **110** regulates the voltage value of the output operation voltage U**3**. Therefore, the telephone switchboard can adapt to the change of the resistance value of the load **300** (e.g. a telephone). In addition, because the output control circuit **130** is capable of directly sourcing the current flowing through the load **300** as the feedback signal FB back to the voltage converter **110**, even if the load **300** has an additional resistance value except for the resistance values on the above-mentioned operation modes, the voltage converter **110** is still capable of changing the voltage value of the output operation voltage U**3** according to a change in the current value. Furthermore, the voltage converter **110** can be formed by an integrated circuit plus discrete components, such as resistors, diodes and capacitors, and the output control circuit **130** is formed by a few simple discrete components. In such a case, the telephone switchboard requires a smaller space than a typical telephone switchboard utilizing a transformer to arrange the power system **10**, and therefore, the telephone switchboard has a smaller size.

Alternatively, the feedback signal FB also can be a voltage feedback signal obtained by sampling the signal levels of the control signal on one of the first and second control terminals **105***a*, **105***b* of the power supply **100** at predetermined intervals. In such a case, when the load **300** is in the on-hook state or in the dialing state, the signal levels of the control signal sampled from the first control terminal **105***a* are always maintained at a high level, or oscillate continuously between a high level and a low level at a predetermined frequency. Then, the voltage converter **110** converts the original operation voltage U**1** to the output operation voltage U**3** having a voltage value corresponding to the load **300** in the dialing or on-hook state. When the signal levels of the control signal require in a predetermined period that a low level is maintained, that is the load **300** is in the dialog state, the voltage converter **110** converts the original operation voltage U**1** to the output operation voltage U**3** suitable for the load **300** in the dialog state.

Although numerous characteristics and advantages of the present embodiments have been set out in the foregoing description, together with details of the structures and functions of the embodiments, the disclosure is illustrative only; and changes may be made in detail, especially in the matters of shape, size and arrangement of parts within the principles of the disclosure to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

What is claimed is:

1. A telephone switchboard for at least one telephone, comprising:

a control unit detecting a working operation mode of the at least one telephone and generating control signals that correspond to the working operation mode of the at least one telephone;

an output control circuit receiving the control signals, controlling direction of current flowing through the at least one telephone according to the received control signals, and generating a feedback signal according to change of the working operation mode of the at least one telephone; and

a voltage converter receiving an original voltage generated by an external circuit, the voltage converter including a feedback terminal for receiving the feedback signal generated from the output control circuit, the voltage converter converting the original voltage into a corresponding output operation voltage according to the feedback signal, and outputting the corresponding output operation voltage to the at least one telephone.

2. The telephone switchboard of claim **1**, further comprising a first control terminal and a second control terminal connected to the control unit for receiving the control signals, wherein the control unit generates two control signals at each working operation mode, the first control terminal receives one of the two control signals, and the second control terminal receives the other of the two control signals.

3. The telephone switchboard of claim **2**, wherein the output control circuit includes a first output circuit, a second output circuit, a first control circuit and a second control circuit, the first output circuit and the second output circuit receive the output operation voltage and are connected to two voltage input terminals of the at least one telephone, the first control circuit receives the control signals applied on the first control terminal and determines whether the output operation voltage is applied to the at least one telephone via the first output circuit according to the received control signal, the second control circuit receives the control signal applied on the second control terminal and determines whether the output operation voltage is applied to the at least one telephone via the second output circuit according to the received control signal.

4. The telephone switchboard of claim **3**, wherein the first output circuit includes a first input terminal connected to the voltage converter for receiving the output operation voltage, a first voltage output terminal connected to one of the two voltage input terminals of the at least one telephone, and a driving terminal connected to the first control circuit, and the second output circuit includes a second input terminal connected to the voltage converter for receiving the output operation voltage, a second voltage output terminal connected to the other of the two voltage input terminals of the at least one telephone, and a driving terminal connected to the second control circuit.

5. The telephone switchboard of claim **4**, wherein each of the first and second output circuits comprises a first switching element, a diode and a resistor, a gate electrode of the first switching element serves as the driving terminal of a corresponding one of the first and second output circuits, a drain electrode of the first switching element is connected to a corresponding one of the two voltage input terminals of the at least one telephone, a source electrode of the first witching element is connected to the voltage converter, an anode of the diode is connected to the drain electrode of a corresponding first switching element, a cathode of the diode is connected to the gate electrodes of the corresponding first switching element, and the resistor is connected between the gate electrode and the source electrode of the corresponding one of the first switching element.

6. The telephone switchboard of claim **5**, wherein each of the first and second control circuits comprises a second switching element, a gate electrode of the second switching element is connected to a corresponding one of the first and second control terminals, a drain electrode of the second switching element is connected to ground, and a source electrode of the second switching element is connected the driving terminal of a corresponding one of the first and second output circuits.

7. The telephone switchboard of claim **3**, wherein the first and second control circuits are connected to a node, the output control circuit further comprises a feedback circuit connected between the node and ground and configured to feed the current flowing through the at least one telephone back to the feedback terminal, and the voltage converter changes a voltage value of the output operation voltage according to a current value of the current on the feedback terminal.

8. The telephone switchboard of claim **7**, wherein the feedback circuit includes a sampling resistor connected between the node and ground, the node is connected to the feedback terminal.

9. The telephone switchboard of claim **3**, wherein the feedback terminal is connected to one of the first and second control terminals, and the voltage converter samples signal levels of the control signal on the feedback terminal at intervals with a predetermined period.

10. The telephone switchboard of claim **1**, wherein the voltage converter comprises a first voltage converter for boosting the power voltage to generate a primary operation voltage, and a second voltage converter for converting the primary operation voltage to the output operation voltage.

11. The telephone switchboard of claim **10**, wherein the first voltage converter is a boosting integrated circuit comprising at least one of a current feedback pin and a voltage feedback pin as the feedback terminal of the voltage converter, and the first voltage converter changes a voltage value of the primary operation voltage according to the feedback signal.

12. An electronic device connected to at least one load, comprising:

a control unit detecting a working operation mode of the at least one load and generating control signals that correspond to the working operation mode of the at least one load; and

a power supply system configured for providing operation voltages to the at least one load, the power supply system comprising:

a voltage input terminal for receiving an original voltage generated by an external circuit;

first and second control terminals connected to the control unit for receiving the control signals;

first and second output terminals connected to two voltage input terminals of the at least one load for providing a corresponding operation voltage to the at least one load;

an output control circuit connected to the first and second control terminals for receiving the control signals, and configured for generating a feedback signal according to change of the operation mode of the at least one load; and

a voltage converter connected to the voltage input terminal and comprising a feedback terminal for receiving the feedback signal generated by the output control circuit, wherein the voltage converter converts the original voltage into a corresponding operation voltage according to the feedback signal, and outputs the corresponding operation voltage to the at least one load, and the output control circuit receives the corresponding operation voltage and controls direction that the corresponding operation voltage is applied to the at least one load according to the received control signals.

13. The electronic device of claim **12**, wherein the output control circuit includes a first output circuit, a second output circuit, a first control circuit and a second control circuit, the first output circuit and the second output circuit are connected to the first and second output terminals, respectively, the first control circuit receives the control signals applied on the first control terminal and determines whether the corresponding operation voltage is applied to the at least one load via the first output circuit according to the received control signals, the second control circuit receives the control signal applied on the second control terminal and determines whether the corresponding operation voltage is applied to the at least one load via the second output circuit according to the received control signals.

14. The electronic device of claim **13**, wherein the first output circuit includes a first input terminal connected to the voltage input terminal, a first voltage output terminal connected to one of the first and second output terminals, and a driving terminal connected to the first control circuit, and the second output circuit includes a second input terminal connected to the voltage input terminal, a second voltage output terminal connected to the other of the first and second output terminals, and a driving terminal connected to the second control circuit.

15. The electronic device of claim **14**, wherein each of the first and second output circuits comprises a first switching element, a diode and a resistor, a gate electrode of the first switching element serves as the driving terminal of a corresponding one of the first and second output circuit, a drain electrode of the first switching element is connected to a corresponding one of the first and second output terminals, a source electrode of the first witching element is connected to the voltage input terminal, an anode of the diode is connected to the drain electrode of a corresponding first switching element, a cathode of the diode is connected to the gate electrode of the corresponding first switching element, and the resistor is connected between the gate electrode and source electrode of the corresponding first switching element.

16. The electronic device of claim **15**, wherein each of the first and second control circuits comprise a second switching element, a gate electrode of the second switching element is connected to a corresponding one of the first and second control terminals, a drain electrode of the second switching element is connected to ground, and a source electrode of the second switching element is connected the driving terminal of a corresponding one of the first and second output circuits.

17. The electronic device of claim **13**, wherein the first and second control circuits are connected to a node, the output control circuit further comprises a feedback circuit connected between the node and ground and configured to feed the current flowing through the at least one load back to the feedback terminal, and the voltage converter changes a voltage value of the output operation voltage according to a current value of the current flowing through the feedback terminal.

18. The electronic device of claim **13**, wherein the feedback terminal is connected to one of the first and second control terminals, and the voltage converter samples signal levels of the control signal on the feedback terminal at intervals with a predetermined period.

19. The electronic device of claim **13**, wherein the voltage converter comprises a first voltage converter for boosting the power voltage to generate a primary operation voltage, and a second voltage converter for converting the primary operation voltage to the output operation voltage.

20. The electronic device of claim **19**, wherein the first voltage converter is a boosting integrated circuit comprising at least one of a current feedback pin and a voltage feedback pin as the feedback terminal of the voltage converter, and the first voltage converter changes a voltage value of the primary operation voltage according to the feedback signal.

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